

# **GOLF CLUB HEAD AND COMPOSITE PLATE THEREFOR**

## **BACKGROUND OF THE INVENTION**

### **1. Field of the Invention**

The present invention relates to a golf club head and a composite plate  
5 therefor. In particular, the present invention relates to a golf club head with a composite plate increasing the adjusting ranges of the center of gravity and of striking sound of the golf club head.

### **2. Description of Related Art**

A typical conventional wooden golf club head is illustrated in Fig. 1 of  
10 the drawings. The golf club head includes a golf club head body 10 and at least one cover plate 20'. The golf club head body 10 is made of metal and includes a striking plate 11 and at least one recession 12. The recession 12 may be defined in a crown portion, a sole portion, or a side portion of the golf club head body 10, depending on the need of the product. The recession 12  
15 includes an opening 121 and a stepped portion 122. The cover plate 20' is a plate made of graphite or light metal by lamination. The cover plate 20' is tightly engaged in the recession 12. Thus, the golf club head body 10 has a relatively low center of gravity as well as a relatively low weight. The position and size of the opening 121 as well as the position, size, and weight  
20 of the cover plate 20' can be varied to rapidly adjust the center of gravity and the weight of the whole golf club head while improving design flexibility.

Despite of the above advantages, the golf club head has some

disadvantages. Firstly, in a case that the cover plate 20' is made of graphite that has a sound-absorbing effect, when striking a golf ball, the pleasing clear and crisp striking sound resulting from resonance of the golf club head body 10 made of metal is sacrificed; namely, it sounds dark and unpleasant when striking a golf ball. Secondly, graphite has a relatively weak structure and thus adversely affects the structural reliability of the golf club head product if a considerable number of cover plates 20' made of graphite is used or the overall area of the cover plate(s) 20' is relatively large.

In a case that the cover plate 20' is made of light metal, the structural strength is improved and the striking sound generated as a result of striking a golf ball is clear and crisp, yet lowering of the center of gravity and adjusting range of the center of gravity are limited. Further, the color and patterns of the cover plate 20' are monotonous no matter the cover plate 20' is made of graphite or light metal, failing to provide added value for the golf club head.

## OBJECTS OF THE INVENTION

An object of the present invention is to provide a composite material for a golf club head to increase adjustment ranges of the center of gravity and of striking sound of the golf club head.

Another object of the present invention is to provide a composite material for a golf club head to provide various colors and patterns for the golf club head, providing added value for the golf club head.

A further object of the present invention is to provide a composite

material for a golf club head to improve the striking performance of the golf club head.

Still another object of the present invention is to provide a golf club head with a composite plate that achieves the above objects.

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### SUMMARY OF THE INVENTION

In accordance with an aspect of the present invention, a golf club head is provided and includes a golf club head body made of metal and having a striking plate, at least one recession defined in the golf club head body, and at least one composite plate engaged in said at least one recession to form a portion of a shell of a golf club head product. The composite plate includes at least one metal layer and at least one non-metal layer that are laminated by pressing.

In accordance with another aspect of the invention, a composite plate is provided for a golf club head and includes at least one metal layer and at least one non-metal layer. Said one metal layer and said at least one non-metal layer are laminated by pressing to form the composite plate.

Other objects, advantages and novel features of this invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings.

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### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an exploded perspective view of a conventional wooden golf club head;

Fig. 2 is an exploded perspective view of a golf club head with a composite plate in accordance with the present invention;

Fig. 3 is a schematic exploded sectional view illustrating formation of a metal layer of the composite plate;

5 Fig. 4 is an exploded perspective view illustrating a mold for manufacturing the composite plate in accordance with the present invention;

Fig. 5 is a sectional view of the golf club head in accordance with the present invention;

10 Fig. 6 is a top view of the golf club head in accordance with the present invention;

Fig. 7 is a sectional view of a modified embodiment of the golf club head in accordance with the present invention;

Fig. 8 is a top view of the golf club head in Fig. 7;

15 Fig. 9 is an enlarged view showing patterns of a modified embodiment of the composite plate;

Fig. 10 is an enlarged view showing patterns of another modified embodiment of the composite plate;

Fig. 11 is an enlarged view showing patterns of a further modified embodiment of the composite plate;

20 Fig. 12 is an enlarged view showing patterns of still another modified embodiment of the composite plate; and

Fig. 13 is an exploded perspective view of yet another modified

embodiment of the composite plate in accordance with the present invention;

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Preferred embodiments of the present invention are now to be described hereinafter in detail, in which the same reference numerals are used  
5 in the preferred embodiments for the same parts as those in the prior art to avoid redundant description.

Referring to Figs. 2 through 4, a golf club head in accordance with the present invention includes a golf club head body 10 and at least one composite plate 20. The golf club head body 10 is made of metal and includes  
10 a striking plate 11 and at least one recession 12. The recession 12 may be defined in an appropriate position of the golf club head, e.g., the crown portion, the sole portion, or the side portion of the golf club head body 10. The recession 12 includes an opening 121 and a stepped portion 122.

The composite plate 20 is tightly engaged in the recession 12, forming  
15 a portion of a shell for the golf club head. The composite plate 20 includes at least one metal layer 21 and at least one non-metal layer (three metal layers 22, 23, and 24 in this embodiment) that are laminated by pressing.

Referring to Fig. 3, the metal layer 21 is made of light metal or alloy having a density smaller than  $4.8 \text{ g/cm}^3$ , preferably magnesium, aluminum,  
20 titanium, or an alloy thereof. Before manufacture, the metal layer 21 is cut to an appropriate size, and a press mold 30 consisting of a first mold part 30a and a second mold part 30b is used to press the metal layer 21. The metal layer 21

is placed on a convex plane 32 of the second mold part 30b and then pressed by the first mold part 30a having a concave plane 31. Thus, the metal layer 21 after pressing has a shape corresponding to the recession 12 of the golf club head body 10. The metal layer 21 has a density smaller than  $4.8 \text{ g/cm}^3$ .  
5 Further, the tensile modulus of the metal layer 21 is between  $3500 \text{ kg/mm}^2$  and  $12000 \text{ kg/mm}^2$ , the elongation of the metal layer 21 is between 5% and 20%, the hardness (HV) of the metal layer 21 is between 45 and 450, and the thickness of the metal layer 21 is between 0.3 mm and 1.5 mm. The above physical/mechanical properties assist in lowering the center of gravity of the  
10 golf club head product and in generation of clear and crisp striking sound when striking a golf ball.

Referring to Fig. 4, in this embodiment, a first non-metal layer 22, a second non-metal layer 23, and a third non-metal layer 24 are provided. The first non-metal layer 22 is superimposed on the metal layer 21, which is  
15 superimposed on the second non-metal layer 23, which, in turn, is superimposed on the third non-metal layer 24. The first non-metal layer 22 is preferably a uni-direction fabric, a plainwoven fabric, or a twilled fabric made of graphite. Typically, the graphite fabric consists of one (1) to five (5) layers of pre-impregnated graphite material oriented at  $0^\circ$ ,  $90^\circ$ , or  $\pm 45^\circ$  and  
20 alternately stacked and glued together at an appropriate high temperature. Thus, the graphite 221 forms patterns on an outer face of the first non-metal layer 22.

The second non-metal layer 23 is preferably made of epoxy. Alternatively, the second non-metal layer 23 can be an adhesive layer of solvent-release type, pressure-sensitive type, heat-sensitive type, or chemically-reactive type. The third non-metal layer 24 is preferably a single  
5 layer of impregnated graphite fabric. After preparation and stacking of the first non-metal layer 22, the metal layer 21, the second non-metal layer 23, and the third non-metal layer 24, another press mold 40 consisting of a first mold part 40a having a concave plane 41 and a second mold part 40b having a convex plane 42 is used to press the metal layer 21 and the non-metal layers  
10 22, 23, and 24. The metal layer 21 and the non-metal layers 22, 23, and 24 are laminated and bonded together to form a composite plate 20 having a density between  $1.7 \text{ g/cm}^3$  and  $4.8 \text{ g/cm}^3$ .

Referring to Figs. 5 and 6, through use of the adhesive such as epoxy, the composite plate 20 is securely and tightly engaged in the recession 12 of  
15 the golf club head body 10, forming a golf club head product. Since the composite plate 20 includes non-metal layers 22, 23, and 24 having relatively lower densities, the center of gravity of the golf club head product is lowered, thereby increasing the inertial moment of the golf club. Further, since the composite plate 20 includes a metal layer 21, clearer and crisper sound (in  
20 comparison with the cover plate 20' of Fig. 1) is generated when striking a golf ball with the golf club. This provides added value for the golf club product. Further, the metal layer 21 provides the composite plate 20 with

improved deforming capacity, which improves the deforming capacity of the striking plate 11 of the golf club head body 10 to an extent. The flying distance of the golf ball stricken by the golf club is increased; namely, the striking performance is improved.

5           The material, thickness, number of layers, and the sequence of the metal layer 21 and the non-metal layers 22, 23, and 24 can be varied, depending on the product need. The position of the center of gravity, the frequency of the striking sound, or the coefficient of restitution of the golf club head can be adjusted. Further, the weaving method of the graphite of the  
10 first non-metal layer 22 that is the outermost layer of the composite plate 20 can be changed to provide various patterns on the outer face of the composite plate 20, providing aesthetically different pleasing appearances for the golf club product.

          Figs. 7 and 8 illustrate a modified embodiment of the invention,  
15 wherein a buffering space is defined between an inner periphery of the recession 12 and an outer periphery of the composite plate 20, and a filler 50 is filled in the buffering space. The filler 50 is preferably an elastomeric paint filler, preferably a paint filler made of thermoplastic elastomer, such as a polyurethane (PU) paint filler. Thus, a buffering space allowing elastomeric  
20 deformation and heat expansion/cooling shrinkage is provided between the composite plate 20 and the recession 12, reducing the possibility of creases, improving the structural strength, and improving the good product rate of the



golf club head. Further, selection of various fillers 50 or combination of different fillers 50 provides various annular patterns on the golf club head product, providing added value for the golf club head product.

Fig. 9 shows a modified embodiment of the composite plate 20. In this embodiment, the first non-metal layer 22 is replaced with a first composite layer 22a that is formed by means of mix-weaving graphite 221 and Kevlar fibers 222 that are properly arranged to form a net-like material. The Kevlar fibers 222 are poly-p-phenylene terephthalamide sold by Dupont Inc. under the name Kevlar®.

Fig. 10 shows another modified embodiment of the composite plate 20. In this embodiment, the first non-metal layer 22 is replaced with a second composite layer 22b that is formed by means of mix-weaving graphite 221 and titanium filaments 223 that are properly arranged to form a net-like material.

Fig. 11 shows a further modified embodiment of the composite plate 20. In this embodiment, the first non-metal layer 22 is replaced with a third composite layer 22c that is formed by means of mix-weaving Kevlar fibers 222 and titanium filaments 223 that are properly arranged to form a net-like material.

Fig. 12 shows still another modified embodiment of the composite plate 20. In this embodiment, the first non-metal layer 22 is replaced with a fourth composite layer 22d that is formed by means of mix-weaving graphite

221, Kevlar fibers 222, and titanium filaments 223 that are properly arranged to form a net-like material.

The physical/mechanical properties of graphite 221, Kevlar fiber 222, and titanium filament 223 are listed in Table 1.

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Table 1

	tensile strength (ksi)	tensile modulus (kg/mm <sup>2</sup> )	elongation (%)	color
graphite	500	24500	2.0	black
Kevlar fiber	350	7400	4.6	golden
mixed weaving of Titanium filaments and graphite	35.2	2400	26.2	sliver/black

As can be seen in Table 1, graphite 221 is black, Kevlar fiber 222 is golden, and titanium filament 223 is silver. Use of graphite 221, Kevlar fibers 222, or titanium filaments 223, or mix-weaving of at least two of them to form the first composite layer 22a, the second composite layer 22b, the third composite layer 22c, or the fourth composite layer 22d provides a change in the color and the patterns on the outer face of the composite plate 20. Thus, the appearance of the golf club head product can be aesthetically pleasing, providing added value for the golf club head product.

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Fig. 13 illustrates yet another modified embodiment of the composite plate 20. In this embodiment, the composite plate 20 includes a metal layer 21

and two non-metal layers 23 and 24. The metal layer 21 is made of a material selected from the group consisting of magnesium, aluminum, titanium, and an alloy thereof. The non-metal layer 23 is preferably made of epoxy, and the non-metal layer 24 is preferably a single layer of impregnated graphite fabric.

- 5 The non-metal layer 23 is the outermost layer of the composite plate 20, providing the composite plate 20 with a metallic appearance. Further, the composite plate 20 increases the adjusting range of the center of gravity of the golf club head product, increases the adjusting range of the striking sound of the golf club head product, and increases the coefficient of restitution of the
- 10 golf club head product. This allows manufacture of a golf club head product with a metallic appearance, low center of gravity, clear and crisp striking sound, and good striking effect.

- While the principles of this invention have been disclosed in connection with specific embodiments, it should be understood by those
- 15 skilled in the art that these descriptions are not intended to limit the scope of the invention, and that any modification and variation without departing the spirit of the invention is intended to be covered by the scope of this invention defined only by the appended claims.